Comment on 'Measuring propagation speed of Coulomb fields' [R. de Sangro *et al.* Eur. Phys. J.C (2015) 75:137]

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Abstract

Some remarks are made on the theoretical interpretation of recent experimental results on the propagation speed of electromagnetic force fields and of previous related experimental and theoretical work

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The conclusion of the experiment described in Ref. [1] is found in the last sentence of the abstract of the paper:

> 'The results we obtain, on a finite lifetime kinematical state are compatible with an electric field rigidly carried by the beam itself'

This is another way of stating that the results are consistent with a propagation speed of Coulomb forces that is instantaneous, or at any rate much greater than the speed of light and not consistent with the retarded field of the Liénard-Wiechert formula. Similar behaviour has been recently reported for magnetic force fields in [2].

This comment points out that such behaviour is predicted by the Relativistic Classical Electro-Dynamics (RCED) theory developed by the present author [3, 4]. In this theory electric and magnetic force fields are mediated by the exchange of space-like virtual photons as in Quantum Electrodynamics. The equations of RCED are derived by considering the classical limit of the QED invariant amplitude for Møller scattering: ee $\rightarrow$ ee. Some comparisons of the theory with text-book Classical Electromagnetism have been worked out in [5], including a demonstration, similar to that of Laplace for gravitational forces [6], of the impossiblity of stable circular Keplerian orbits with retarded electromagnetic force fields. See also the related work on the speed of gravitational forces reported in Ref. [7].

Earlier evidence for a superluminal propagation of microwave fields in the near zone was obtained by Mugnai, Ranfagni and Ruggeri [8]. Evidence for superluminal signal propagation in the near field region has also been obtained in some recent amateur experiments [9, 10, 11]. Indeed, as pointed out by Smirnov-Rueda [12], evidence for similar effects was even observed (but not published [13]) in Hertz' original experiments on electromagnetic wave propagation [14].

Ref. [1] cites a paper by the present author [15] where the derivation of retarded fields as calculated by Liénard[16] and Wiechert [17] was critically reviewed. This showed, as

previously pointed out by Whitney [18], that an elementary mathematical error due to miscalculation of the effective charge density of a moving charge occurs in the derivation of the retarded Liénard-Wiechert potentials. Corrected formulas for retarded potentials and fields were given (see also Ref. [19]). However, this work is not related to the force fields measured in Ref. [1] which are instead consistent with the instantaneous RCED force fields mentioned above.

In conclusion, the additional information, related to the work presented in Ref. [1], given in this comment, is:

- A theoretical prediction (Refs. [3, 4]) of the observed non-retarded nature of Coulombic force fields.
- A precise reference [6] to the work of Laplace demonstrating the non-retarded nature of gravitational force fields.
- Citation of previous experimental results, consistent with the findings of Ref. [1], but not mentioned in it (Refs. [8-13]).
- Pointing out that the paper [15] (cited as Ref. [6] in [1]) which discusses only retarded force fields, has no direct relevance to the explanation of the results of [1].
- Noting (as previously shown in Ref. [18]), that the Liénard-Wiechert potentials, used for calculation of retarded fields in Ref. [1], are invalid due to a simple mathematical error in their derivation, and that the corrected retarded potentials may be found in Ref. [15].

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